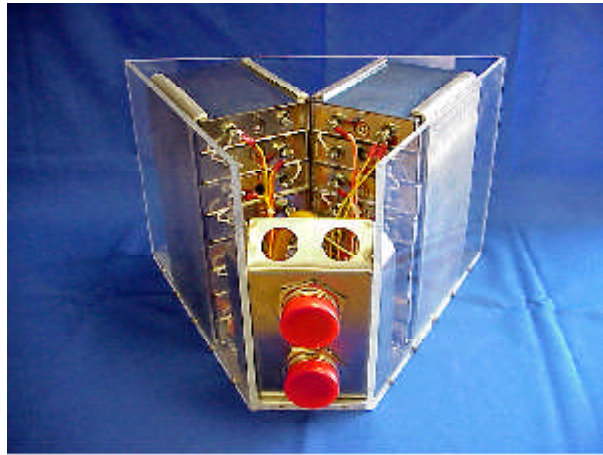


Testing Conducted for Lithium-Ion Cell and Battery Verification

The NASA Glenn Research Center has been conducting in-house testing in support of NASA's Lithium-Ion Cell Verification Test Program, which is evaluating the performance of lithium-ion cells and batteries for NASA mission operations. The test program is supported by NASA's Office of Aerospace Technology under the NASA Aerospace Flight Battery Systems Program, which serves to bridge the gap between the development of technology advances and the realization of these advances into mission applications.



Mars 2001 lander battery.

During fiscal year 2003, much of the in-house testing effort focused on the evaluation of a flight battery originally intended for use on the Mars Surveyor Program 2001 Lander. Results of this testing will be compared with the results for similar batteries being tested at the Jet Propulsion Laboratory, the Air Force Research Laboratory, and the Naval Research Laboratory. Ultimately, this work will be used to validate lithium-ion battery technology for future space missions.

The Mars Surveyor Program 2001 Lander battery was characterized at several different voltages and temperatures before life-cycle testing was begun. During characterization, the battery displayed excellent capacity and efficiency characteristics across a range of temperatures and charge/discharge conditions. Currently, the battery is undergoing life-cycle testing at 0 °C and 40-percent depth of discharge under low-Earth-orbit (LEO) conditions.

LEO conditions simulate the operations on orbit. An orbit is approximately 90 min long and consists of 55 min of charge time while the satellite is in the Sun and 35 min of discharge time during the portion of the orbit when the Earth casts a shadow on the satellite. The battery is the main source of power during the dark portion of the orbit. The goal is to demonstrate 5 years of life, or 30,000 cycles, under LEO conditions.

An additional in-house effort involves the cycling of several single lithium-ion cells that are

being used as test articles to provide critical data necessary to define parameters and test conditions for NASA's Lithium-Ion Cell Verification Test Program. This testing will be used to develop wakeup procedures for cells that have been in storage and cell-matching procedures for selecting multiple cells for a single pack.

The purpose of this program is to evaluate the performance of cells from several different vendors at different temperatures, depths of discharge, and charge cutoff voltages. The resulting database of information will be essential for predicting performance and establishing the capabilities of lithium-ion batteries for aerospace missions. The Lithium-Ion Cell Verification Test Program is a NASA-led effort headed by Glenn with participation from the other NASA centers involved in space programs, the Central Intelligence Agency, the National Reconnaissance Organization, the Air Force, the Navy, and the Aerospace Corporation.

The in-house testing discussed is being conducted in the Electrochemical Cell and Battery Test Facility, a newly renovated facility of Glenn's Electrochemistry Branch dedicated to the characterization and testing of aerospace cells and batteries. It supports cell and battery development and validation efforts for future NASA missions. It is equipped to perform testing on lithium-ion cells and batteries and other battery chemistries.

The facility is equipped with three Arbin Instruments battery testing units and four environmental chambers. Cells and batteries with capacities up to 200 A-hr and voltages as high as 45 V can be tested in inert environments at controlled temperatures of -40 to 120 °C. Different charge and discharge regimes can be simulated, including LEO, geosynchronous-Earth-orbit, mission profiles, and other predefined load profiles.

>Find out more about this research:

<http://www.grc.nasa.gov/WWW/Electrochemistry/>

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